FM radio: family interplay with sonic mementos

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FM Radio: Family Interplay with Sonic Mementos

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ABSTRACT

Digital mementos are increasingly problematic, as people acquire large amounts of digital belongings that are hard to access and often forgotten. Based on fieldwork with 10 families, we designed a new type of *embodied digital memento*, the FM Radio. It allows families to access and play sonic mementos of their previous holidays. We describe our underlying design motivation where recordings are presented as a series of channels on an old fashioned radio. User feedback suggests that the device met our design goals: being playful and intriguing, easy to use and social. It facilitated family interaction, and allowed ready access to mementos, thus sharing many of the properties of physical mementos that we intended to trigger.

Author Keywords

Memories, mementos, narrative, audio, tangible interaction.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Today's technology makes it possible to accumulate extensive personal digital collections. Developments in digital cameras, networking, and storage now mean that many people have gigabytes of digital belongings. But digital collections are not viewed or acted upon in the same way as their physical counterparts. Prior work reveals that digital collections tend to be perceived as *invisible* and *inaccessible* [16]. People are far less likely to choose digital than physical memorabilia when asked to select important mementos in their home [15]. They also have difficulties in retrieving important items from their digital collections, e.g. they are often unsuccessful at finding older digital photos [24]. Part of the reason is that owners of digital collections seem to acquire more stuff, but expend little time in organizing or accessing it, leaving it to accumulate on their hard drive [1]. There is a vicious circle operating here: poor organization means that digital mementos are hard to access; as a result, collections are seldom accessed, so that poor organisation is undiscovered. In contrast, physical mementos are sifted and organised into photo albums, memory boxes or household mementos making them straightforward and fun to access [5, 9, 16].

We address these problems with digital mementos by exploring a new design approach. Rather than leaving digital mementos 'imprisoned' in a computer, we explore ways that digital collections can be made more accessible, interesting and better integrated into people's everyday lives. Our new designs also need to fit seamlessly into the home by appropriating familiar objects and metaphors. We explore the concept of *embodied digital mementos* of 'sonic souvenirs', family recordings taken during summer holidays. Our design allows these to be accessed through a familiar domestic object: a radio (Fig. 1). We shed light on the motivation, design and evaluation of devices for personal digital mementos, by studying how digital sound can engender and enhance collective family reminiscing.

Fig. 1 Three siblings interacting with the Family Memory Radio.

The Family Memory Radio (FM Radio, Fig. 1) is a digitally enhanced object designed to reflect insights from a field study: 10 families recorded 'sonic souvenirs' (audio mementos) of their holiday in summer 2008. Our design was intended to easily fit in the home being embodied as a familiar object. By using a radio we maintained the evocativeness and ambiguity of sound, at the same time allowing for easy exploration of the sonic collection. Each family's sounds were uploaded to the FM Radio and given

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back to the family in Summer 2009, for reminiscing about the previous year's holiday.

We first summarise initial fieldwork that explores sonic memorabilia and family reminiscing. We then describe our design motivations for FM Radio, followed by the families' impressions and feedback. Observations of how the family listened and interacted with their collection stimulated reflection on the effectiveness of our design decisions. We also derive general principles for designing technology for affective interaction with personal digital mementos.

RELATED WORK

Technology for reminiscing about personal photos has been the focus of much HCI research. There are many proposals for the home, e.g., using augmented objects and the TV [9, 12], multiple interactive digital frames [11, 20], or a tabletop [18]. However little work has been done to explore the role of sound and how people interact with it. This could be due to the difficulties in navigating and accessing audio [25]. An exception is a recent study on domestic sound has shown its value [13, 14].

To overcome the problem of accessing sounds, designs that explore audio for personal recollection have embedded it in tangible objects, old mementos [6, 19] or newly created squeezable devices [14]. More traditional storage (on a PC) but using a radically new pictorial interface has been explored in StoryBank [7].

Some research on family photos has explored combinations of images and recorded sound, involving special devices that play back the sound linked to the photo [5]. Other research has explored sound in different contexts: e.g. for visually impaired users [21], on mobile devices [23], for increasing the engagement with audiences in public spaces [17] and in interactive environments [4].

There is also research into the general nature of reminiscence. Autobiographical memories very often have a social dimension. Talk about the past is shaped by who is present and the social relations between participants [2, 5]. Studies in sociology have explicitly looked at collective remembering as a way to tighten social bonds [8]. Shared experiences and shared narratives are at the core of collective memories. Some authors claim that individual, autobiographical memory only exists as a narrative to others, as social narrative [22].

Taken together, the literature both from HCI and sociology poses interesting but unanswered questions about the nature and place of audio in the fabric of a family home.

CAPTURING AND LISTENING TO SONIC MEMENTOS

In summer 2008, we invited families to capture "sonic souvenirs" of their holiday. Instead of the usual practice of collecting visual images (i.e. photos) as holiday mementos, we asked them to actively record and select *sounds* that would make up a representative collection of their holiday. Using sound also allowed us to investigate the role of narrative in reminiscing. The study is discussed in more detail in [3]. Here we summarise the methodology and report only results relevant for the design of the FM Radio.

Methodology

Participating families had to have at least a child aged 7-15 and to go on holiday for a minimum of 7 days. In 3 days of their choice they had to capture memorable aspects of their holidays using sound only, i.e. no pictures could be taken on those "sound only days". We hoped this constraint would encourage participants to develop practices around recording sounds, and reflect on the relation between sound and memory. We hoped it might also allow us to gain insight into the suitability of sound as a medium for memory related story telling, especially when unaccompanied by photos or videos. For the remainder of their holiday, participants were free to use any device or medium, such as picture and video cameras, or if they chose, the sound recorders we provided. We asked them to record a minimum of 30 sounds throughout their holiday. They were completely free as to the *kinds* of sounds they wished to record.

Ten families were recruited and given Olympus Dictaphone DS 30 digital voice recorders to use during the study. Before the families left for their holiday, a researcher met them at their homes to give orienting instructions and a hands-on tutorial on how to use the digital recorder. Within 3 weeks of their return, the same researcher visited the families to collect their impressions conducting a follow-up interview and to collect the sounds they had recorded. Most family members were present and took an active part in that second discussion. They laughed and recounted their holidays while sharing sounds as well as holiday pictures. We also asked them as a family to select 10 favourite sounds and compare their choices with the well-known practice of taking and talking about pictures.

Results

Every family recorded a different number of sounds, from only 9 to an impressive 197, and the clip lengths varied between 30s-12min. The variety of sounds recorded was broad: mock interviews, family conversations, giggles, pseudo radio shows, commentary about what they were doing (waiting in an airport, having breakfast), family arguments, ambient sounds both natural (animals, water) and human (volleyball match, murder mystery game), created sounds (bubbles blown with a straw in water, the creak of a door). A few participants recorded verbal diaries or more abstract reflections about their trip, e.g. their favourite parts of the holiday.

Each family and each individual within the family seemed to have a personal style in recording: some introduced the sound with a comment, others did not; some participants favoured recordings of ambient sounds, while others took an active role making sound or performing. During recollection, participants were sometimes listening for the first time to the sounds recorded by other family members. This happened regularly for children's performances (e.g. radio shows, singing) that parents were unaware had been

recorded. Listening was very much a social activity, with the author of the recording explaining what it was and the other members joining in. It was clear that any device for family recollection needs to reinforce this social aspect of *collective engagement*.

Sounds were very *evocative* and seemed to engender deeper and more specific sensations than a picture could convey. Commenting on the recording of a volleyball match one family said:

Mum: "*So when you see a picture of it though it's a frozen moment. Here you're hearing a sort of –*"

Dad: "- *And the focus, if you saw a picture the focus would be the ball. And here the focus is much more on the people taking part.*"

Mum: "*Although I'm thinking, when I'm listening to it, I'm thinking the green grass. I'm thinking about being out of doors. It's quite a different quality with the sound.*"

This perceived contrast between the evocativeness of sound and pictures was echoed by other participants: "*With a photo, in my head, I just picture the photo itself. But when there's a sound […] I can see everyone, and imagine them actually doing it, not just frozen*", and "*With a camera, you wouldn't necessarily get how bored we were because it rained so much.*" In our FM Radio design we wanted to preserve the evocativeness of sound. We wanted to evoke these personal interpretations - allowing sounds to mean different things to different people.

We also wanted to preserve the *engagement* people experienced when attempting to interpret a sound. Only a few participants recorded explicit comments about what each sound was, instead the majority recorded stand-alone sounds. As a result, when listening, participants had to pay attention and sometimes re-listen to what they heard. Animated discussions about what the recording was and where it took place were not unusual:

Mum: "*Is it water or rain? It's going very fast. Is this [Dad's] nature sound?*"

Dad: "*I don't know, let's listen*."

Child: "*I know what it is. It's when [the dog] was crossing the river. There was a waterfall.*"

Dad: "*I don't know, I did not record that.*"

[the sound ends]

Mum: "*So was it water or rain?*"

[they re-listen turning the volume up]

Dad: "*Whatever it was, it was quite nice.*"

Dad then (re)constructed a story inferring that the recording was associated with a walk along a river. Questioned about providing a commentary for the sound while recording for easier interpretation after, Dad said: "*to have recorded what it was would have made it obvious*", Mum: "*it wouldn't have made your memory work so hard.*" Participants seemed to enjoy this ambiguity and not mind too much whether they could precisely locate the event. Participants sometimes had to listen carefully before they could recognize the sound. Compared with images, audio has an aura of 'mystery': revealing its full meaning only after extended listening. The FM Radio design should emphasise this suspense and preserve the sense of magic as listeners wait for the audio to reveal itself.

Previous research indicated the need for technology to be immediate, and ready to use. There is also a degree of reluctance to adopt standard digital technology in the home space as it affects the style of a room [16]. After reminiscing about their sonic souvenirs, we prompted our participants about what would be an acceptable form of memento technology for the home. Examples mentioned included: a sketching board to associate sound and images, objects to squeeze to produce sound or that play when a person moves closer. There was a clear generation gap with younger participants preferring a techie look, "*it would be cool*". Parents rejected automatic solutions, "*something that plays when you walk in would be really irritating*", or intrusive displays, "*the idea of sketching and attaching sounds does not appeal to me.*" A tangible solution suggested playfulness: "*I like the idea of having something with the sounds on, then you shake it or do something. That would be quite fun.*"

Implications for Design

The open ended task of collecting Sonic Souvenirs generated strong evidence for the benefits of audio as an affective memory medium. It also informed the design possibilities and challenges to making sound more accessible. At the same time, by participating in the initial study, families created a collection of mementos of personal value. Having such a collection was a prerequisite for evaluating personal technology.

Sound is a special kind of digital memento. It does not exist in any other form, i.e. printing isn't possible. It is also very different from images as it unfolds in time as opposed to being instantaneous. As a result, it seems to engender more personal memories and feelings than images: "*photographs are very objective, you see what it is, while with sound people would think different things.*" We wanted our design to maintain this evocativeness. Unlike other work [5], we therefore excluded the association of sounds with images even though this makes it easier to discriminate between sounds. Making sound easy to navigate while keeping it mysterious and evocative was a design challenge, but we considered this critical to induce engagement.

Listening to sonic souvenirs was highly engaging for the whole family. They laughed and talked while playing the sounds. With this in mind, we aimed at a design that preserves collaborative social engagement (i.e. instantaneous exchange of device control). We wanted to

make access to audio files straightforward in order to sustain an uninterrupted flow.

Another defining quality of sound is that listening is not 'attention exclusive'. Listening can be done at the same time as other activities. Based on prior work [20], we aimed at designing around people's lives more than realizing technological possibilities. It was therefore fundamental to support a context of use that is integrated into everyday life - that does not require looking at a computer. Thus you should be able to listen to sonic memorabilia while cooking.

Naming and organizing files is tedious, and using a computer to play audio was perceived as intruding between the family and their sonic mementos. Thus, another design constraint was that the device be playful, and different from normal PC interaction; it had to be surprising and fun. As a final constraint, we wanted an object that could easily fit the home, which would not look like a digital gadget. As with physical mementos we wanted this object to trigger social conversation. In developing design concepts we considered the aesthetic and the materiality as important as the technology.

NEW TECHNOLOGY IN AN OLD-FASHIONED SHELL

Design Rationale

The starting point for our design was a classic transistor radio. Our intention in designing a novel device that borrows heavily from the design language of an old radio was twofold: firstly, we felt that the classic aesthetic of the object would attract and encourage families to adopt this new technology into their home; and, secondly, we hoped that, by modelling the interface around existing concepts of radio controls, we could exploit familiarity with the purpose and operation of this novel device. The radio would also serve to make the sounds visible and accessible, acting as a tangible reminder to the family of what it holds. By embodying users' sonic souvenirs in a familiar, easily controllable physical object we also hoped to avoid the problems associated with other digital memorabilia, namely that these are invisible and inaccessible [16].

The radio form-factor was also representative of the way we believe families might best engage with their sonic mementos. A radio is clearly not a personal audio-playback device like an iPod, and it encourages a shared listening experience. It is relatively small, light, and - aside from power – does not require external infrastructure to operate. As with a traditional radio, the interface was intended to require minimal visual attention and only occasional input, emphasizing instead the interactive aural experience. This requirement stemmed from our understanding of how and when the sonic collection might be replayed: not only collectively but also in a relatively passive and peripheral manner, perhaps while multi-tasking or attending to other activities that demand visual focus.

The requirements that resulted from our design rationale did not readily map to any existing audio-playback device. We therefore needed to create a bespoke appliance that we could give families to evaluate their reactions to a working prototype. The rest of this section details the design decisions and implementation strategy involved in the realization of the Family Memory Radio.

Content Organization: Radio Channels

Personal content is essential for personal technology. However, as the recent literature on retrieving digital photos shows [24], navigating to, and finding items can be challenging and frustrating. To make navigation easier, we decided to organize the collection around the concept of *channels*. A channel is a subset of sonic files of the same type that a user can "tune to" to play back the sounds it contains. A user is able to explicitly browse a channel by moving backwards and forwards through the sequence of sounds. When a particular sound is over, playback is automatically advanced to the next sound in the channel list, looping back to the beginning when all sounds have been played. Grouping homogeneous sounds into themed channels makes the navigation through the sound collection easier. The design also supports continuous and passive listening (initiated by tuning into a channel), or active and explicit interaction with the content (by changing channel, or navigating within a channel).

To decide which channel classification was best we listened to all the recordings. As mentioned above collections were extremely heterogeneous. We considered several options, including a personalized classification for each family. However four channels found general consensus:

Time Travel: contains all the sounds played in order by the day and time they were recorded;

Ambient: contains the natural sounds, such as water or animals, as well as 'human produced' sounds, such as the sound of walking in the woods or blowing bubbles with a straw; here the playing order is chronological;

Voices: contains all human sounds including intentional speech, such as performances or interviews, background conversations, or human activities, such as playing games or praying; the playing order is chronological;

Favourites: contains the sounds selected by the family as favourites in chronological order. This channel is updated every time the user presses the 'favourite' button during playback (see Interface (re)Design section and Figure 2 bottom): the sound currently playing is added to the end of favourite channel.

The number of channels we should support was a matter of much deliberation. Having more channels results in more specific categories, each containing a smaller subset of sounds. This would make it easier to navigate through a channel to find and replay a particular sound. However, fewer channels would necessitate that users be more active in their interaction with the radio: they would have to frequently change these fewer channels to avoid repetitive playback of a single set of sounds. We decided to organize

the sounds into relatively broad categories as described above and discuss alternatives with the families during the feedback visit.

Interface (Re)Design

The basis for our FM Radio prototype is a Roberts R707 radio, first manufactured in the early 1970's, which we found and purchased on eBay. We chose this model because of its clean, simple and elegant design. The original control panel of the R707 (Fig 2, top) includes a number and variety of mechanical controls that we hoped to reuse and map to the digital functionality of our interface: four rotary knobs, one toggle push-button, and four radio-buttons. Many different mappings and control layouts were considered. The final design (Figure 2, bottom) maintains a similar style to the original, along with some necessary cosmetic and functional changes.

In the original radio, the left knob was used to control the volume and power state of the radio (moving it beyond the minimum volume level powered the radio off). In the FM Radio this knob maintains a similar functionality. Turning it clockwise will first turn the FM Radio on and starts playback of the selected channel at the desired volume.

The bank of radio buttons and single push-button was maintained in our redesign, but their functionality re-interpreted. Originally, these buttons allowed the user to select the tuning frequency of the radio (Short Wave, Medium Wave, Long Wave, VHF); in our design, the four buttons are placed adjacent to a set of dynamic labels that display the name of the four channels (Fig. 2 middle: Time Travel, Ambient, Voices, Favourites). Pressing a radio button causes its associated channel to be selected, and all other channels to be deselected – through the original mechanical design of the radio buttons, any deselected channel pops up automatically, providing unambiguous, consistent visual and tactile feedback about its state. The fifth button, which is mechanically independent of the radio button bank, is associated with the static label "Mark as Favourite." Pressing this button during playback adds the currently selected track to the Favourites channel.

The right "Tuning" knob allows the user to navigate within a selected channel. Turning it a small distance anticlockwise causes playback to skip back a few seconds. A clockwise has the opposite effect. Together these allow users to find and replay a particular segment of a sound. A quick turn of the knob will to skip to the next or previous sound in the channel. This dual functionality of fine-and-coarse navigation is analogous to the way Fast-forward and Rewind buttons operate in many examples of digital music equipment. We felt it was appropriate to replicate this to support navigation, even though this diverged from the strict radio analogy.

There are some further subtleties in the design of the FM Radio interface that are worth mentioning. Once playback starts, a channel plays continuously, one sound after another, looping back to the first sound on reaching the last sound in the channel. When the FM Radio is turned off, or the channel is changed, playback of the current channel stops: when the radio is turned back on or the channel is re-selected, the play resumes from its previous position.

Figure 2. The original Roberts R707 (top); the redesigned FM Radio (bottom) and its interface (middle).

The dynamic labels associated with each channel make it easy to change the name associated with each sound set (see Implementation, below). We strongly considered the idea of using these dynamic labels to also display the name of the currently-playing sound. The main motivation for this would be to allow users to browse and recall sounds by their name. However, as mentioned previously, the process of naming individual sounds was cumbersome and tedious, and we felt that, in practice, users would not go through the process of exhaustively naming their sounds. Furthermore, in some cases, the names that were assigned to a sound were sometimes guesswork, and might prove to be misleading when re-listening at a later date.

The radio does not support 'sound management': sorting, naming and organizing sounds was considered a task to be done on a PC where a display, mouse and keyboard are available; user-defined folders could then easily be uploaded back on the radio. Only the 'Mark as Favourite' option was designed to support organization during playback. This requires minimal interaction: users can select individual sounds for simple recall at a later point. In balancing these concerns, we opted for a design where sound identification happens exclusively through its aural dimension and chronological ordering within a channel.

In general, we steered away from design choices that entailed unnecessarily frequent interaction with the radio controls. We wanted to balance the need to provide controls for users to navigate and find content, with support for passive browsing, unobtrusive background listening and immersive reminiscing.

Implementation

We considered a number of implementation strategies. In essence, the device is a digital sound player, so we considered the possibility of making use of an off-the-shelf personal music player, such as an Apple iPod, to provide the core playback functionality. However, the difficulty of remotely controlling such a device, interfacing it with the mechanical controls of the radio, synchronizing with its internal state or implementing our concept of channels made the idea infeasible. Another alternative we considered was to use a laptop or tablet PC, but the size constraints of the Roberts R707 radio case severely limited our choice of suitable devices. In addition, this option implied the overhead of having to implement our appliance on top of an operating system, which implied long start-up times and the possibility of non-deterministic behaviour.

We chose instead to develop the FM Radio using an experimental modular hardware platform, Dragonfly. The platform is based on a small but powerful embedded processing unit to which a number of electronic modules can be easily connected. Modules provide additional capabilities for input, output, communications, power, display, sensing and actuation. Modules can be easily connected and disconnected using a standardized interconnection mechanism, making the hardware very flexible and reusable. The hardware can be programmed in a high-level, object-oriented language and live-debugged from within a development environment that provides sophisticated debugging tools.

In large part, the FM Radio was implemented using the standard hardware modules pictured in Figure 3: the *Mainboard* provides core processing functionalities; the *TFT Display* module is used to enable the dynamic channel labels; the *Knob* is used for the Tuning control; the *Programming* module doubles power supply for the system; the *USB* module allows a memory-stick (containing the sound files, encoded in MP3 format) to be connected, and the *Audio* module decodes and reproduces the MP3 files.

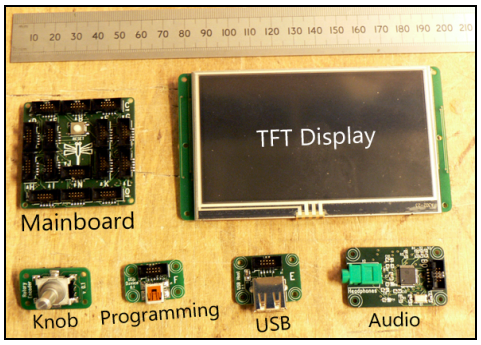

Figure 3. The enabling modular hardware components

In addition to these modules, two of the original radio controls were adapted as bespoke modules, allowing them to connect directly to the system (see Figure 4, top). The rotary potentiometer and switch which served as the original Volume/Power control was connected to an Analog-To-Digital converter on the Mainboard, allowing it to decode its position, and used to digitally control the volume level of the Audio module. The original radio-buttons were connected in such a way as to serve as digital input controls. The original control faceplate was replaced by a similar reproduction, which included the new and adapted controls in a new layout (Figure 4, middle). In the completed faceplate, the TFT display is only visible through slits that act as the dynamic labels for the channel-selection buttons.

The assembled system, including a pair of stereo speakers and amplifier (which is powered from the main circuit) fits easily within the radio case, from which the original electronics have been carefully removed (Figure 4, bottom). The USB module is mounted on the back panel for easy access, allowing a memory-stick to be quickly changed. When the system is powered on, its program checks the contents of the memory-stick. The names of the first four directories found on the root of the drive form the basis of the channel names, which are then displayed on the dynamic labels. The contents of each of these directories are used to generate playlists corresponding to each of the four channels. This mechanism allows users who are comfortable with file management to remove the memory-stick and connect it to a PC in order to change the name and contents of each channel.

LISTENING TO AND INTERACTING WITH FM RADIO

Set-up and Data Collection

The design of FM Radio as an embodied playful device for collective reminiscing was evaluated with the families who participated in the initial Sonic Souvenirs study. One year after making their recordings, we invited them to use the Radio for revisiting the sounds they collected in summer 2008. We contacted only families who had recorded more than 50 sounds. We imposed this threshold to sustain sound exploration over time, as fewer sounds would have led to repetitive playing. Six families accepted our invitation with enthusiasm; 23 people took part. The families were

unaware of what we had designed: we mentioned they would be asked to try out "a device" and provide some feedback. This intentional "secrecy" allowed us to capture initial impressions about the Radio and how participants first related to it.

Figure 4. The digitally-enhanced original radio controls (top), the replacement control panel assembly (middle), and the assembled FM Radio (bottom)

The visit lasted 60 to 90 minutes. It was video recorded for further analysis, and was organized into three phases. We first asked families if they had used the Dictaphone since summer 2008 and probed whether they had re-listened to their recordings we had stored on their PC. The radio was then taken out of a box and positioned where every member of the family could reach it. They were invited to try it out by themselves and figure out how it worked. No instructions on how to operate the radio were given - as we wanted to probe how much our design afforded a natural interaction. Every member of the family was encouraged to experiment with the radio hands-on to explore the sounds.

When the radio was on the table, the researcher retreated into the background, acting as a quiet observer of the family dynamic as they were interacting, listening, reminiscing and playing their sounds. After about 30 minutes of self-discovery, ten open questions were posed to investigate: their feelings on re-listening to their sounds, their perception of the interaction, the aesthetic of the radio and its projected use in family life. Observed behaviours and comments made during the interaction were used to stimulate discussion and further elicit participants' views.

The videos were analysed and comments transcribed whenever appropriate; the behaviour of the family members while listening and interacting with the radio was noted. Comments and actions were grouped by similarity.

User Feedback

Recording and Re-listening with Dictaphone and PC

To our surprise, all families had used their Dictaphone in the past year. In 2 instances the mother used it for professional purposes, but in all others the motivation was consistent with our topic of study, i.e. personal recording for social recollection. Motivations were different: a teenager loaded her music on it and recorded friends and parties; a mother recorded (unaware) children in their bedroom playing and other snippets of family life; a father recorded his father's 80th birthday party and the speeches made; a father and child recorded a special family event. This shows an appropriation of the mode of recording sounds and participants perception of the value of sound. However there were clear limitations in the current technology: everyone complained about the difficulty in retrieving sounds from the device. Only the 80th birthday speech was downloaded from and sent to the grandparents as a memento. The other families rarely listened to what they had captured - making "disposable" use of their Dictaphone sounds by deleting old files when the device was full.

As part of the initial study we transferred people's sonic souvenirs to their PC. Consistent with prior research [16], re-listening to sounds on the PC was rare and happened by chance. When the sounds were on parents' laptop, several happened to re-discover the directory while looking for something else. They all reported being puzzled at first by what that directory contained, as they had forgotten they had it. They then played a few snippets, describing the experience as evocative and enjoyable.

To summarize, we found clear barriers to accessing and recording sonic mementos. Our next question was whether FM Radio could overcome these.

Evocativeness and Reminiscing

When the radio was put on the table there was a general sense of surprise. The expectation seemed to be that families would see a shiny new piece of digital technology. With the parents there was immediate recognition, followed by jokes about remembering similar radios. In contrast, the children did not seem to have a clue about the device as today's audio technology (e.g. MP3 players) looks very different. Hands-on exploration was done by the whole family collectively, with the parents often suggesting the right action, e.g. press a button to select another channel, most likely because of their familiarity with knobs and buttons, from previous experience with older technology.

Listening to sounds on the FM Radio engendered extensive laughter and family jokes very much in the same way as in the initial study. What was radically different was the *social interaction* focused on the device: e.g. when a sound recorded by a child (e.g. funny or mocking noises) was played s/he immediately wanted to interrupt it, whereas siblings wanted to play it repeatedly. This conflict over the controls (Figure 1) was an expression of sibling rivalry observed in many families which usually ended up in shared laughter. Clearly the Radio afforded a level of collective interaction that neither the Dictaphone nor the PC allowed. Participants commented on how much better their experience was with the radio: "*with [the Dictaphone] you have to pass it around and lean on it*". It is also a more democratic way of accessing common memories than a PC: "*the files are on my laptop and [the kids] don't have easy access to it*". The radio therefore seemed to overcome perceived barriers with current ways of accessing digital memorabilia.

In addition to these moments of direct interaction, families became deeply involved in listening and reminiscing. They discussed when a certain sound was recorded and talked about different aspects of the holiday that were often unrelated to the clip. They explored the different channels exhaustively to listen to their entire collections. All families commented on the excellent quality of the audio and how vivid the event was: "*it's incredible! It seems like having him in this room!*" Again they explained how the radio made listening to their sounds a much better experience compared to a Dictaphone or PC, thus supporting our design goals.

Style and Function

Adults and children both liked the old fashioned style, although one adult would have preferred a smaller size, and another was not concerned with any style. Its distinctive look made it an intrinsically interesting object. Just as with physical mementos [15], people saw it is being a *prompt* for conversation: "*I can see visitors asking about it. It would make a good conversation point*". Only one person, a child, saw it as a private device to keep in their bedroom. This is a clear indication that our decision to use an old fashioned object as a shell for digital technology is appropriate and should make the radio a provocative talking point.

The size of the radio and embodied character was noted as being good for reminding. Unlike the Dictaphone or mementos on the PC, where digital collections are often forgotten, participants thought that the physical presence of the radio would *remind* them about their sounds and promote playing – addressing the invisibility problem with many digital collections. Participants were confident that the device would not end up forgotten and unused in a drawer "*like so many digital gadgets we have*". Such reminding could prompt more recordings of sound as personal mementos: *"[while listening to the sounds] I regret I did not record more this year. I suppose it is a matter of remembering that we can*."

When questioned *where* they would place it, all families indicated a common room, e.g. the lounge, the dining room or the kitchen. This choice was consistent with our design goal of having an object that could be accessed, talked about and shared by the entire family (in contrast to both Dictaphone and PC). The exact location chosen depended on the audience people foresaw: some could only contemplate listening to it with immediate-family members, whereas others saw it as being a resource for friends and more extended family. Of course the mobility of the device, and the fact that it fits aesthetically into multiple locations makes it easy to relocate the radio, allowing these multiple functions to be satisfied. Although families tended to say that they would find a specific place for it and leave it there, there was some discussion on the varied uses different members of the family could foresee. The same person suggested both personal and social uses: "*I can easily imagine listening to it doing odd jobs, like washing up*" and "*while having a barbeque with the friends we were with in Paris – that would make a nice background*". This combined personal and collective use, occurred in others' comments. Suggestions of individual use were varied: "*while doing the homework*", "*potting in the cellar*", "*cooking*", "*while on the computer*". Envisaged social uses varied as well: "*at family meals – when we are all together and talk*", "*when we relax*", "*grandma would like this*", "*with friends*". The comments clearly show how the range of possible uses envisaged by participants is broader than we had imagined, while remaining consistent with our aim to support both individual and social use. The comments underline how the unlike the Dictaphone or PC, the radio exploits sound's affordances: sounds can play in the background but could suddenly become the focus if anything triggers attention.

There was minor concern about boring sounds might be for those who did not participate in the original event. People also mentioned ethical issues about recording people and replaying their sounds to others. And some recordings, e.g. private comments or jokes, were felt to be ill-adapted for sharing at large. A recurring suggestion was for sounds to serve as background to photo sharing. Some people wanted sounds and images synchronized so that sounds captured at the same place and time would be triggered together (like in [5]). However, when we discussed the effort of manually tagging/linking photos and sound, most were happy with much looser association between these.

Feelings and Appropriation

Everyone liked the organization of sounds in time and favourites. But there was less consensus about the other channels, as individuals in the same family wanted their own channel. Parents liked the idea of a children's channel where their changing voices would be recorded year after year: "*that would be a very sentimental channel - them as babbling babies, then their first words and now their jokes*"; children instead preferred recordings of activities or

events for playing them to a specific group of friends: "*[my channels would be] 'good', 'bad' and 'boring'* ".

Random (shuffle) was considered a desirable feature. People imagined using the radio in family games involving who could identify the sound first. People also wanted to mix sounds with music. They wanted their personal digital music on a dedicated Radio channel and to randomly mix personal sounds with that music. This suggests users should be supported in organizing their sounds in their own way on a PC, but allowed to scroll and select a channel, among many, at the time of listening.

Participants were willing to create and organize their own folders and all but one agreed that a PC would be the best tool for this. The one person who wanted to organize files on the radio motivated it by saying that the context would trigger him into action and he would never organize anything if he were forced to sit at a PC to do this dull job. The 'Favourites' was appreciated as it allows real-time organization with minimal effort. However it was pointed out that different people within the family may have different favourites.

Affordances and Usability

Figuring out what the "Tuning" knob did took a little time, provoking much discussion and fun. In one family the children repeatedly turned the knob back, re-playing the same snipped over and over: "*That's cool! It's a rap!*" When the forward/rewind functionality was discovered, the analogy with the fast-forward control of many devices (e.g., DVD or MP3 players) was immediately mentioned showing a successful metaphor mapping. The tangible interaction was much appreciated by parents and children alike: "*there is a physical satisfaction in pressing a mechanical button or turning a knob*", "*it's cool, I want to show it to my friends*". There seems to be a sense of durability and rewarding tangibility connected with the mechanical clicking.

Two easily addressable usability issues emerged. When powered on, the radio displays the channel names giving the impression it is ready to play. Participants started pressing the buttons expecting the sound to start. They then quickly spotted the 'off' label on the 'Volume' knob and turned to starting playing. Lighting the screen only when the knob is turned on would easily fix this. The second issue was the lack of prominent feedback on the display when the 'Tuning' knob is turned: while trying to discover what that knob was for, participants turned it slowly, but a slow turn produces a limited skip forward in the playing. The change in the audio was thus difficult to perceive leaving the impression that nothing had happened. This led to much discussion on the lack of feedback about where one was in the channel, e.g. the beginning, middle or end. Indeed if any visual feedback were provided on the channel display there would have been no question about whether the knob was working. In addition two families tried to find a specific sound they remembered recording. In both cases they had to spend considerable time browsing through different channels, and when they found it there was no way to know where it was located. Marking it as favourite would be a first step but this would not entirely solve their problem as they would still have to scroll through the "Favourites" channel to retrieve it. The most common suggestion to improve feedback was to have a slide-bar with a tag showing the current position. We discussed this at the design stage as it fitted the radio metaphor, but rejected it as taking up too much space. We therefore discussed other options with the families, i.e. to provide the number of the current snippet so that it would be possible to retrieve it quite easily by scrolling to the right position. However this proposal did not induce much enthusiasm even when it was observed that re-finding would be much more efficient: "*I don't mind to have to listen to few sounds to find it when I roughly know where it is. It is not like work when you have to be efficient, is it?*" All families wanted to retrieve specific sounds particularly if the number of sounds in channels is high or they wanted to play something specific to a visitor. Proposals included some form of editing, and more sophisticated (iPod like) browsing functions.

CONCLUSION

The design of the FM Radio was motivated by a field study that provided direct evidence of the potential of sound for capturing and reminiscing for families. However our fieldwork left room for exploring several design possibilities. Our main decision was radical, to diverge from current digital audio technology, reverting to the basic properties of sound and the core interactions with it. Nevertheless when confronted our design, families reacted very positively to experiencing personal audio using a bespoke appliance. The evaluation showed FM Radio met our design requirements as it (1) supports browsing in a non task-oriented way, (2) encourages playfulness, exploration, reminiscing (3) allows the mnemonic experience to be inclusive, and shared by many at the same time (4) embodiment increased accessibility, serving to remind people about their mementos.

Some clear lessons emerge for designing innovative devices for personal digital mementos. Our fieldwork was rigorous enough to provide guidance for taking design decisions, but open enough to inspire creativity. That investigation with potential final users was also essential for collecting personal data to be used later in the evaluation. Obviously reactions would have been very different to someone else's recordings. Secondly the design should not stem from what technology is available but from the intended effect and use. We were therefore committed to a social device that was directly focused on the sound experience.

Design has to find an effective compromise between affordances, constraints and intended functionality. In implementing the FM Radio, we strove to remain sensitive to the original design of the Roberts R707. Within the freedom of the design space, we were guided by the original aesthetics, and whenever possible tried to make use

of existing controls and operational affordances. The families greatly appreciated the result that would not be achievable in any other way thus exemplifying how digital technology can be inspired by past non-digital products.

The challenge of implementing the FM Radio as a robust and fully-functional bespoke appliance was made considerably simpler by the use of our experimental modular platform – equally in terms of supplying the enabling electronics, programming the functionality and interaction, and physically integrating the components into an existing case design. The process of development made us consider the wider implications and future possibilities of using and reusing existing artefacts as shells for new information appliances and embedded interactive devices. The enthusiasm the FM Radio received during the evaluation clearly supports this reflection, and indicates that injecting obsolete and vintage objects with new technology, updating their functionality and prolonging their relevance in daily use is an interesting alternative for the development of digital technology intended for the home.

In conclusion, participant reactions demonstrated our design represents a promising approach to designing digital memorabilia, overcoming prior barriers of invisibility and inaccessibility. Embodying sound in the radio promoted evocative collective reminiscing, sharing many of the properties of physical mementos that we intended to trigger.

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